Review of the Biological Opinion of the Klamath Hydroelectric Settlement Agreement and accompanying EIS

An External Independent Peer Review Report

Produced by

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Produced for

The Center for Independent Experts (CIE)

Executive Summary:

This review was conducted mainly to identify the strengths and weaknesses of recent opinions concerning the impacts of the Klamath River dam removal plans. The review focused primarily on the data, assumptions, and analytical methods used to determine the plausible impacts of the combined actions on salmon, eulachon, sturgeon and some marine mammals, with particular emphasis on sediment loads and herbicide application. In terms of strengths, this review indicates that this is a good summary of work conducted by specialists in many fields/disciplines, and amounts to an authoritative compilation of scientifically credible predictions. These in turn are used make seemingly well supported inferences on the combined impacts of the various actions planned.

In terms of weaknesses, in its present format, the draft report does not do justice to all the background work conducted, partly because of many missing references and other editorial shortcomings. Some assessment results are not very encouraging in that the actions are likely to have substantial adverse impacts on several life history stages of some species. It would be desirable to make some revisions to the report text, include more details on alternative measures currently being considered (if any) to further minimize the predicted negative impacts, and if the model predictions will be updated periodically with new information before demolition begins in 2019.

My major conclusions concerning the six major issues to focus on according to the Terms of Reference (*ToR*) are as follows;

ToR 1: Are the assumptions and the effects conclusions in the biological opinion scientifically reasonable/supportable and logical, especially pertaining to the suspended sediment analysis?

Yes, by and large they are. In general, the effect analysis is considered to be reasonable, supportable and logical. Efforts should be made to further investigate some hypotheses before 2019, particularly those based on laboratory investigation results used to make inferences about impacts on non-salmon species under natural conditions.

ToR 2: Is the herbicide effects analysis in the draft biological opinion scientifically reasonable/supportable and logical?

In general, the comments in section 6.1 appear to be scientifically sound, and based on information published in scientific journals. The predicted effects also account for the use for additional precautionary measures that should result in lower concentrations of herbicide than those possibly causing even sub-lethal effects. On this basis, the effect analysis is considered to be reasonable, supportable and logical. Ideally, more details should be provided on the surfactants used, why/when maximum dosages are needed, and alternatives to glyphosate still being considered for use in sensitive areas and/or under adverse conditions.

ToR 3: Are the critical habitat and coho salmon effects analysis comprehensive?

Yes they appear to be, with no major gaps detected (omitting missing references). Plausible impacts were assessed using scientifically credible methods, survey results, peer reviewed analytical procedures and pertinent facts. The authors might consider modifying some passages relating to a few coho biology issues mentioned in the general comments section (below).

ToR 4: Are there any missing critical assumptions and effects to fish and habitat (coho, eulachon and green sturgeon) that should be in the draft biological opinion?

Most assumptions appear to be reasonable, and scientifically credible procedures were used to determine plausible effects. The authors might consider conducting further investigations on the effects of sediments on the early life stages of eulachon and green sturgeon before 2019, and identify potential methods to speed up sturgeon recovery if impacts are potentially severe.

ToR 5: What sections of the draft biological opinion need to be improved, and any recommendations on how?

Information on what can/will be done to rectify information gaps and update model forecasts before 2019 would help re-assure readers that alternative plans will still be evaluated as additional data become available before 2019. A list of additional or alternative mitigation/restoration measures still being considered or evaluated would be helpful.

ToR 6: Does the biological opinion represent the best scientific information available?

I hesitate to state categorically at this stage that the opinion is 'the best', but to a large extent it does appear to be based on "some of the best scientific information available". There is always room for improvement, but there is rarely (if ever) unlimited resources to address every conceivable issue and all unavoidable uncertainties about the future.

Background :

Pursuant to the National Environmental Policy Act (NEPA), the Department of the Interior (Department), through the Bureau of Reclamation (Reclamation), intend to prepare an EIS/EIR to consider removing four dams on the mainstem Klamath River pursuant to the terms of the Klamath Hydroelectric Settlement Agreement (KHSA), thereby proposing the largest dam removal restoration action in US history. Conflicts over water and other natural resources in the Klamath Basin between conservationists, tribes, farmers, fishermen, and State and Federal agencies have existed for decades. Since 2003, the United States has spent over $500 million in the Klamath Basin for irrigation, fisheries, National Wildlife Refuges, and other resource enhancements and management actions. Consequently, the United States, the States of California and Oregon, the Klamath, Karuk, and Yurok Tribes, Klamath Project Water Users, and other Klamath River Basin stakeholders negotiated the Klamath Basin Restoration Agreement (KBRA) and the KHSA (including the Secretarial Determination) to resolve long-standing disputes between them regarding a broad range of natural resource issues. This is a landmark federal action with a recent litigious history. The project has large potential

implications on the economy of California and Oregon, commercial, tribal and recreational fisheries in California and Oregon, and tribal and public trust resources.

Several government agencies have already been involved in conducting pre-post impact assessments associated with planned dam removals, with the U.S. National Marine Fisheries Service (NMFS) and Fish and Wildlife Service (FWS) charged with providing advice on how to minimize potential impacts on some aquatic natural resources in fresh water and marine environments. Some of the latest assessments conducted integrate the results of past studies to determine if the predicted overall impacts of dam removals and the proposed actions to mitigate these will have substantial adverse impacts on some species of fish and marine mammals during and after dam removals. The NMFS Office of Science and Technology coordinates and manages a contract providing external expertise through the Center for Independent Experts (CIE) to conduct independent peer reviews of NMFS scientific projects. Each CIE reviewer is contracted to deliver an independent peer review report to be approved by the CIE Steering Committee. As a selected CIE reviewer, the present report summarizes my findings in accordance with the Statement of Work (SoW), Terms of Reference (ToR), and the report format specified by the CIE.

Description of the reviewer role and review activities:

The reviewer shall conduct an impartial and independent peer review in accordance with the SoW and ToRs herein. CIE reviewers shall have the combined working knowledge and recent experience in the application of hydrology, river restoration, and pacific salmon life history needs. Each CIE reviewer's duties shall not exceed a maximum of 10 days to complete all work tasks of the peer review described herein. The reviewer must complete the review (desk review, with no travel required) according to required format and content as described in Annex 1:

1. The CIE independent report shall be prefaced with an Executive Summary providing a concise summary of the findings and recommendations, and specify whether the science reviewed is the best scientific information available.
2. The main body of the reviewer report shall consist of a Background, Description of the Individual Reviewer's Role in the Review Activities, Summary of Findings for each ToR in which the weaknesses and strengths are described, and Conclusions and Recommendations in accordance with the ToRs.
3. The reviewer report shall include the following appendices:
   Appendix 1: Bibliography of materials provided for review
   Appendix 2: A copy of the CIE Statement of Work

The CIE reviewer must also complete the independent peer review addressing each ToR as described in Annex 2:

1. Are the assumptions and the effects conclusions in the biological opinion scientifically reasonable/supportable and logical, especially pertaining to the suspended sediment analysis?
2. Is the herbicide effects analysis in the draft biological opinion scientifically reasonable/supportable and logical?
3. Are the critical habitat and coho salmon effects analysis comprehensive?

4. Are there any missing critical assumptions and effects to fish and habitat (coho, eulachon, and green sturgeon) that should be in the draft biological opinion?
5. What sections of the draft biological opinion need to be improved, and any recommendations on how?
6. Does the biological opinion represent the best scientific information available?

Specific Tasks for CIE Reviewers: The following chronological list of tasks shall be completed by each CIE reviewer in a timely manner as specified in the **Schedule of Milestones and Deliverables.**

(1) Conduct necessary pre-review preparations, including the review of background material and reports provided by the NMFS Project Contact in advance of the peer review.
(2) Conduct an independent peer review in accordance with the ToRs (**Annex 2**).
(3) No later than 16 January **2012**, each CIE reviewer shall submit an independent peer review report addressed to the "Center for Independent Experts," and sent to Mr. Manoj Shivlani, CIE Lead Coordinator, via email to shivlanim@bellsouth.net, and CIE Regional Coordinator, David Die, via email to ddie@rsmas.miami.edu. Each CIE report shall be written using the format and content requirements specified in Annex 1, and address each ToR in **Annex 2**.

It should be noted that during the review period, CIE officials (Jim Simondet) informed the reviewer on Dec 18th that (i) the review should cover the master opinion document and the separate killer whale analysis report (Anon. 2011) as a single draft opinion. Then on January 12th, 2012, CIE officials (Roberto Koeneke) informed the reviewer that the original ToR with 7 review items was not correct and replaced by a new ToR with 6 items, some of which were substantially different. Following further inquiry by the CIE reviewer for extra time to correct/adjust the review, on January 14th, 2012, the CIE Lead Coordinator (Mr. Manoj Shivlani) agreed to extend the deadline for report submission to January 23rd, 2012, or at most one week after the original deadline (Jan. 16th, 2012).

Summary of Findings:

Main Document Reviews:

1. Review of NMFS-FWS (2011)

Editorial comments:

- An unacceptably large number of papers are cited but not listed in the Reference Section of the main report. These include: Ackerman et al. 2007-2008-2009, Allen et al. 2006, Allen and Hassler 1986, Anderson 2000, Armstrong and Ward 2008, Asarian et al. 2009-2010, Atkinsone and Bartholomew 2010a-b, Bailey and Houde 1989, Baraclough 1964, Barrett et al. 1984, Barrowman et al. 2003, Bartholomew et al. 1997, Briggs 1953, Buhle et al. 2009, Beacham et al. 2005, Beamer et al. 2010, Beeman et al. 2008, Berman and Quinn 1991, Bevelhimer and Coutant 2006, Bishop et al. 1989, Bjork and Bartholomew 2010, Bliesnet et al. 2006, Brommer 2000, Brommer et al. 1998-2002, Butler et al. 2010, Carter and Kirk 2008, Clutton-Brock 1998, Carpio 2010, Chesney and

Knetchtle 2011a, Chiasson 1993, Clarke 2007, Connelly and Lyons 2007, Coulson et al. 2006, Crozier et al. 2008, Dean 1994-1995, Dobson 2003, Doppelt et al. 2008, Drake and Wilson 1991, Dunsmoor and Huntington 2006, Ellis 1962, Emmett et al. 1991, Farnsworth and Warrick 2007, Fausch 1986, Feely et al. 2008, FEMAT 1993, Gearheart et al. 1995, Greimann 2010, Greimann et al. 2011, Hartman 1965, Hart and McHugh 1944, Harr and Nichols 1993, Haupt 1959, Hayes 1983, Healey 1991, Henning et al. 2006, Hetrick et al. 2009, Hicks et al. 1991, Hillemeier et al. 2009, Hinch et al. 1996, Hinch and Bratty 2000, Hiner 2006, Holtby 1988, Horne and Goldman 1994, Huang and Greimann 2010, Jahn 2010, Jennings 1996, Johnson et al. 1990, Jong et al. 2008, Jong and Mills 1992, Kann and Walker 1999, Karas 2011, Kirk et al. 2010, Ketcheson and Froehlich 1978, Kotiaho et al. 2005, Lande 1993, Lake and Hintch 1999, Larson and Belchik 1998, Lewis et al. 2009, Lloyd 1987, Luers et al. 2006, Magahan and Nowlin 1976, Magneson and Wright 2010, Matthews et al. 1994, McFarlane et al. 2000, McGraw and Caswell 1996, McHenry et al. 1994, McLeay et al. 1984, McMahon 1983, Melbourne and Hastings 2008, Miller et al. 2010, Mills and Beatty 1979, Minkley et al. 1986, Moyle 1976, Montgomery and Buffington 1997, Morrisson et al. 2002, Moyle et al. 2008, Murphy 1995, Musick et al. 2000, Nakamura and Swanson 1993, Newcombe and MacDonald 1991, Newton and Rotherty 1997, Nielsen 1998, NMFS 2010b, Nordwall 1999, Newcombe and MacDonald 1991, Odemar 1964, Oli and Roff 2002, Olson 1996, Peterson et al. 2010, Phillips et al. 2007, Portner and Knust 2007, Rabe and Calonje 2009, Raymond 2008-2009-2010, Reclamation 2011a, Reed et al. 2007, Reid 1998, Reid and Dunne 1984, Redding and Schreck 1987, Rexstad and Pikitch 1986, Reyff 2009, Reynolds 1983, Rowmmich and McGowan 1995, Ruggerone 2000, Sartori 2006, Schaffer 1981, Sharber and Carothers 1988, Sharma and Hilborn 2001, Shaw et al. 1997, Schieff et al. 2001, Scheiff and Zedonis 2011, Schulenburger et al. 1999, Scott and Crossman 1973, Sharr et al. 2000, Simpson Resource Company 2002, Singer 2011, Sinnott 2007-2010, Snyder and Morace 1997, Soto et al. 2009, Stearns 1992, Stillwater Sciences 2010, Stocking et al. 2007, Strange 2008-2009, Sturdevant et al. 1999, Sullivan 1989, Sullivan et al. 1987-2011, Suren 1998, Swanson and Lienkamper 1978, Swanston 1991, Swanson and Dyrness 1975, Swanston and Swanson 1976, Thomas et al. 1993, Turchin 2003, True et al. 2010, Vanderkooi et al. 2010, Varyu and, Voight 2008, Wainwright et al. 2008, Wallace 2004, Walters et al. 2001, Watercourse Engineering Inc 2011, West et al. 1990, Wheatcroft et al. 1997, Whitman et al. 1982, Wildish and Power 1985, Wright 1999, Wydoski and Whitney 1979, YTEP 2005, Yoshiyama and Moyle 2010, Zabel 2006, Zamon and Welch 2005.

- The absence of reference limits the depth of the review that can be conducted. Ideally all references cited should be listed, even if these are provided in 'supporting' documents. Upon scrutiny, some of the reports cited in this report are summaries of investigations conducted on species other than the ones of interest here, but this is not stated as such in the text at times (like citing white sturgeon papers when the focus is on green sturgeon, as in P.4). Also, the reference section and the main text should be corrected for spacing and format problems, inconsistent punctuation, spelling errors, non-use of italics for scientific names, and so forth. The text also contains a large number of

abbreviations, acronyms and definitions that should be listed in a separate table, so the reader does not have to check the previous pages to try to find what EFH, DEQ, ESU, DPS or many others. Fortunately, some support documents have these like Williams et al. (2008, p.viii-xi) and Dunne et al. (2011, P.14) for example. Readers of the main document should not have to consult these as well.

General comments:

- Sections 2.0-2.4 describe demolition procedures and schedules. Mainly for engineers with background knowledge of the context. Difficult for others to see where there might be deficiencies, but the text and tables do indicate that considerable work was done to determine what was needed to deal with all aspects of the dam removal, at least as planned so far.

- P.21. 'All captured adults will be transported and released upstream …. The relocated fish would be able to migrate upstream and spawn in the mainstem or tributary streams'. Relocated adults could try to home back to other natal grounds after release instead of spawning in alternative areas provided. It may be necessary to spread them out over suitable spawning grounds and then block off sections to prevent them from searching endlessly for other streams or settle for bad spawning areas by necessity.

- P.22. Lower paragraph regarding trucking sub-yearling and yearlings to locations downstream. Would likely disrupt the imprinting process to some extent and may cause additional stress/mortalities. Many similar trucking operations conducted in/around British Columbia (BC) hatcheries have been less successful than hoped for. Releasing smolts later in the spring may be preferable, and would amount to an interesting experiment to test the hypothesis that 'survival would be higher' (as claimed). If so, the time and size at release targets currently used by hatchery managers could be adjusted to take advantage of more suitable estuarine conditions now occurring at different times than in recent history (see Bilton et al. 1982, cited in the Report References).

- P.29-32. Section 3.1 is well written and clarifies the process used to assess impacts and risks. Population Viability Analyses (PVAs) are usually conducted to determine long term viability of a population subject to various pressures. PVA models vary in complexity, with some being overly simplistic and others very detailed and well parameterized. This report should specify which model was used (if any) by MacElhany et al. (2000) to set thresholds to determine Viable Salmonid Populations (VSP) for the next 100 years (an unrealistically long forecasting period when new impacts are expected). A cursory review of some additional background material provided for the present review (Appendix 1) revealed that Williams et al. (2008, P.16-19) did not conduct PVA's on coho for various reasons, and relied instead on Allendorf et al. (1997) 'surrogate criteria' to assess risks. The authors also noted it would be desirable to use peer-reviewed PVA's results to support their recommendations. This should be clearly stated in the report if the same approach was used for all species.

- P.37. Extreme conditions are not well defined. Conditions <10th percentile, or >90th as well? Please clarify. Most likely 'normal' scenario defined as ≥median value (or 50th percentile). This threshold is arbitrarily defined, and based on data collected since 1948 when climatic conditions may have been statistically different than says in the most recent 20 years. Might be wise to re-assess the threshold values used. In fact, on first reading, the first few paragraphs of P.37 are slightly confusing and should be re-worded.

- P.39. Third paragraph. Judging from the text, the model developed by Newcome and Jensen (1996) is mainly for salmonids. Some may argue it is doubtful sturgeons are affected by sediment loads as salmon are, simply because of their biological attributes, physiological requirements, and habitat preferences. Juvenile and adult sturgeon can likely tolerate heavier loads of SSC and for longer periods than salmon, because they regularly occupy and/or forage in areas on or near the streambed where sediments accumulate. In the absence of lab studies and ancillary observations from tracking studies, this issue remains unresolved. But to clarify it, one could conduct additional lab studies (akin to those of Newcome and Jensen's) before 2019 to determine if their criteria are applicable to green sturgeon. The same for Eulachon. Could update the main report in due time if need be.

- P.45. [e.g., failure to find mates…] The term is Allee effects, after Allee et al. (1949). A following sentence 'In general, declining productivity equates to declining population abundance'. Way too general and needs to be qualified. Many salmon populations are more productive (in terms to recruits-spawners, or R/S) at lower levels than maximum observed historically, with greater productivity often at about 1/4th to 1/3rd of the replacement level (1:1).

- P.50. Please clarify: spawner densities of x females per km. Is this for the entire river, certain drainages, or specific streams/reaches with potential spawning areas of x km^2.

- P.51. Reference is made to specific locations. Fortunately, I have access to several maps, but other readers might not. This report should include a map with key locations well identified.

- P.52. lower paragraph: 'available data indicates that many populations have declined, which reflects a declining productivity'. Some scientists argue that coho salmon productivity trends are often best described by a Beverton-Holt model than a Ricker model, in which case productivity does not decline or increase beyond a certain level of spawner abundance. But this issue aside, as stated above, some populations are more productive at relatively low spawning levels, and the authors should be careful about stating categorically that declining stock sizes necessarily equate to declining productivity. Might be best to say that in the present context (w/out estimates of S_{MSY}), it is 'hypothesized that …'. It could also be stated that a geographical compression of the range due to loss of less productive stocks occupying peripheral streams amounts to a net loss in total river production over time.

- P.55. lower paragraph: 'the cause of the decline is likely from ocean conditions and the widespread degradation of habitat'. Sounds reasonable in this context but many other factors could have contributed as well, like cumulative fishing impacts over the last few decades inducing substantial loss in genetic diversity (some runs gone), leading to a lower ability of the remaining stock aggregate to adapt to new conditions. This is not akin to just 'over-fishing' mentioned in P.56. Best to rephrase; 'it is currently hypothesized that the recent decline is mainly due to …'

- P.57. Top line. 'Harvest rate estimates for the other two tribal fisheries are not available'. This issue needs to be addressed. A blanket statement seems insufficient. Is there any evidence or reports that the harvest is considerable, substantial, negligible, or else? Ideally there should be some strict controls or limits to subsistence fishery harvests, given all that is being invested for dam removal and conservation purposes. Traditional cultural harvests could possibly be reduced for a while (and compensated for via negotiations) to facilitate wild stock protection and rebuilding.

- P.58. 'On average, coastal coho populations are unable to replace themselves when marine survival falls below about 3%'. The Klamath river coho populations are not typical of those using small coastal streams, but upper tributaries of a large river at a much lower latitude than those examined by Bradford and Irvine (2000) [not Bradford et al. 2000 as cited]. This observation aside, one should hesitate to infer that coho populations are doomed if marine survival drops below 3%. Nobody can forecast with certainty coho marine survival rates in the near future, how long populations can tolerate unfavorable ocean conditions, and if they can adapt with or w/out human assistance. Furthermore those paying for dam removals may conclude there is no point forging ahead if ocean conditions are worsening and coho populations are doomed. Best to first check the reports cited, and re-word accordingly.

- P.60. Section on woody debris. Much work has been conducted on this issue over the past 2-3 decades. Neither the reports of Reid (1998) or Swanston (1991) are cited in the Reference Section, so reviewers can't gage the extent of the literature review. Nor are the numerous key papers written by Slaney, Martin and others (in B.C, Canada) for stream restoration, minimizing logging impacts, and etc. The LWD sections could be improved citing classics, new technologies and alternative habitat restoration methods.

- P.63.The authors did not conduct an extensive literature review of coho straying patterns. There may be few scientifically credible figures available that apply to the current context or the upper tributaries of large rivers, but scientifically credible information is available on straying rates of geographically close hatchery/wild stocks of coho salmon. See Wehrhahn and Powell (1987), Labelle (1992), etc.

- P.65. 'Marine ecosystems face an entirely unique set of stressors related to global climate change, all of which may have deleterious impacts on coho salmon and survival

while at sea'. Nobody can forecast with certainty what the impacts of changing conditions will be, and how fast they will happen, and how fast salmon can adapt. There may be new stressors, but also new conditions favorable to salmon. So rather than picturing the future as a 'doom-and-gloom' scenario for salmon, the authors may consider re-wording some passages. The authors may state that some changes in coastal ocean conditions have been observed in the past 1-2 decades, and based on the trends observed, there is concern that coho salmon may be exposed to marine rearing conditions less favorable that experienced in the past.

- P.75. Section 5.1 seems to be missing.

- P.90. 'Baseline information on the distribution and occurrence of most salmonid pathogens is limited.' Need to specify this is for the Klamath R. system. The scientific literature has much information on fresh water salmon pathogens (periodicity, density, etc.) for several systems on the west coast of North America.

- P.98. 'in the future when robust population data become available'. What is robust data? Scientists often use robust estimators and robust models, but the term robust data is not commonly used and should be clarified.

- P.99. Relatively low abundance in one year does not mean a salmon population is endangered for years to come, especially if multiple age groups spawn (e.g., chinook, steelhead). A literature review will reveal that some populations have recovered after short periods of hatchery supplementation following a disaster of some sort (toxic chemical spills, over-exploitation, etc.). Also 'the fraction of naturally spawning fish within a given population that are of hatchery origin not exceed 5% in order to be at low risk of extinction'. It is doubtful this statement is largely based on empirical evidence. If a spawning population has 8% hatchery fish contribution in one year is no guarantee it is at moderate or high risk or extinction in the near future. Be best to search the literature to determine what level of hatchery supplementation (same donor stock, +reared/stocked properly, and for how long) lead to the demise of that stock. At best, these criteria are theoretical thresholds that serve for stock management in the absence of empirical evidence. Suggest the authors adjust those passages accordingly.

- P.102. 'In addition, spawner data indicate that the amount of recruits produced per female spawner in the Upper Trinity River is substantially less than two'. Is this statement based on full information, i.e., estimates of adult harvest in marine and fresh water fisheries from CWT or DNA estimates of stock composition in catches ?. If so, this should be stated. Using only escapement records (subject to measurement error) is not sufficient, so the authors should clarify and/or re-phrase accordingly. Same for the similar statement on p.103 for the Lower Trinity River.

- P.103. section 5.2.2.9. What evidence do the authors have to assume that hatchery and wild juvenile coho survival rates should be identical or even similar. This assumption is

tenuous at best, and as noted above for P.63, a literature review could show cases where this assumption does not always hold.

- P.103-104. Many redundancies. Similar statements in preceding sections. Please remove redundancies or simplify.

- P.104. 'The Lower Klamath is not discussed here…. because if falls within the boundaries of the Yurok Tribe Reservation… and are excluded from critical habitat designation… are also not covered below because they are out of the action area'. Such omissions may be difficult to accept for some readers, particularly with impact assessments for projects of this magnitude. This gap needs to be addressed somehow. Readers have no clue if there are major problems in this area that can have a large influence on the recovery plan. At a minimum, the report should include statements like 'given anecdotal information and reports from xx communities, all indications are that there are no major… in this area'. However, if some as suspected, these need to be accounted for in the assessment models, even if the hypothesized impacts are characterized by large uncertainties.

- P.109. (email correspondence from BOR to I. Lagomarsino). This needs to be removed if additional details cannot be provided. As it reads, this means nothing.

- P.110. A linear relation is implied. Would a polynomial of order x be justifiable? An eyeball fit suggests a cyclic pattern of some sorts in the time series shown. One wonders if the serial autocorrelation has properly been corrected for by BOR staff, or there is an additional factor at play whose influence is not accounted for. This should be checked.

- P.111. 'Iron Gate turbine venting'. Usually done by pumping air, but oxygen can also be added to minimize nitrogen gas problems under some conditions. Gather adequate engineering work has been done to determine the best procedure to use in this context, but did not read mention of possible gas problems (if any).

- P.115 'Ocean exploitation rates are anticipated to be negligible in 2008'. Anticipated 4 years ago? Do the authors mean 2010, 2011?. And 'post-season estimates are not performed due to the lack of …. Tribal and other harvest effects are expected to continue'. As noted earlier, such issues need to be addressed, particularly when dealing with impact assessments for projects of this magnitude. Here again, at a minimum, the report should include statements like 'given anecdotal information, reports from xx communities, DNA analyses of catch bio-samples, all indications are that there are no major… in this area'. However, if some are suspected, these need to be accounted for in the assessment models, even if hypothesized impacts are characterized by large uncertainties. More information could be provided in footers like at the bottom of P.115.

- P. 122. 'Re-establishing historical habitat associated with opening new spawning areas is likely to increase the spatial structure of SONCC coho salmon'. This may take many

years, or require out-planting fry to new areas, having surplus escapement combined with straying to colonize new areas, coho adapting to new conditions, no additional and unforeseen impacts, etc. Consider 'new spawning areas can potentially increase…'

- P.128. Pinniped predation section. Continued increase in pinniped abundance or predation impacts in approach waters will not facilitate the recovery of salmon populations. If the seemingly outdated Marine Mammal Protection Act can't be amended, one should consider remedial actions of various types (electric barriers beyond tidal reaches, visual or acoustic deterrents, relocations, etc.). Should be some justification for exceptional measures in exceptional circumstances, as when abundance levels reach or exceed historical highs.

- P.146. 'The maximum estimated number of adult coho salmon that might be injured or prevented ….. as a result of the increased suspended sediment concentrations would be approximately 30'. These are far-fetched predictions of future states that are impossible to defend scientifically. Instead of specifying a number, might be safer to state a range, like x-xx% of potential spawners that year.

- P.156. 'Winter studies in Alaska…' Doubt the results apply to the current context, as the habitats are radically different in many ways, including the demographic traits of coho stocks occupying both regions. Might be best to omit, or use results of studies conducted much further south.

- P.161. Trend lines in Fig. 29 are similar and not easily distinguishable (at least in B/W copies). Hard to tell if the peaks are 'no action' or 'dam removal' trends. Please adjust.

- P.168-…. Conclusions. The Proposed Action will have many adverse effects in 2019-2020, and in some cases, for several years after. Most of these are due to sediments loads and transport, temperature changes and dissolved [O_2]. In fact, if the impacts are larger than predicted, it is not unreasonable to assume that some runs may end up close to extirpation given their current state. Leads one to wonder if anything further more could be done to minimize potential impacts or accelerate the recovery process. Without reading all supported documents, hard to determine what additional methods/actions have been contemplated, but wonder if these were considered; creating additional thermal refugia at key sites before demolition starts, creating side spawning channels at key locations to provide incubation habitats that are groundwater fed with high [O_2] and silt loads, supplemental oxygenation of key areas via the use of hypolimnetic aeration (see Ashley 1985, 2000; Ashley et al. 2009), predator controls, captive broodstock programs, etc. Perhaps a few comments on this issue in the main report would help convince readers that other methods are still being considered.

2. *Review of Anon (2011): Separate Sections 1.3.7-8 on Killer Whales and Steller Sea Lions, of NMFS-FWS (2011, above).*

Editorial comments:

- Here as well, some papers cited but not listed in the Reference Section. These include: Hanson et al. 2010a-b, and Winship and Trites 2003. The latter is provided is the reference section of the present review. The various formulas given in text format throughout this report do not use standard mathematical symbols and notation as in technical reports and primary publications. Furthermore, they amount to simple deterministic equations that provide no information on the possible range of various estimates. Improvements should be made by having a sub-section for all equations, symbols and definitions, and simple Monte-Carlo simulations could serve to compute the plausible upper and lower bounds of estimates.

General comments:

- P.4. By contrast to the main report (NMFS-FWS 2011), the present authors recognize to a greater extent the level of uncertainty associated with impact forecasts, and emphasize the need to revise these in due time, as evidenced by the statement: 'new information could become available in future years that may change our analysis of the effects or the interpretation of the results'. In general, the paucity of data precludes the accurate estimation of marine predator impacts on Pacific salmon species (see Christensen and Trites, 2011). However, the author viewpoints potentially apply to many other analyses and forecasts of the main report. Since this constitutes sections 1.3.7 and 1.3.8 of the main report, it would seem desirable to ensure the comments are not perceived as applying only to the marine mammal section. The main report authors should consider emphasizing this, and highlight the need to update various impact forecasts before 2019. Similar statements made by some authors should be emphasized in the main report as well, such as Dunne et al. (2011, P.iii) 'the questions raised by the Panel are not [yet] answerable in quantitative terms'.

- P.8. 'There is no definitive timeline for how and when these improved habitat conditions will affect Klamath salmon populations'. This might be re-worded so it does not seemingly contradict statements in the main report, where timelines are more clearly specified.

- P.8. Last paragraph states that hatchery closure will have a beneficial impact. Yes and No. Hatchery supplementation can help restore depleted populations, reduce predator impacts (eat hatchery fish instead of wild fish), and even help minimize genetic bottlenecks. Hatchery supplementation is not always detrimental.

- P.13. Authors mention the loss of productivity to provide crude estimates. Without conducting a second detailed review of the main report, not sure the productivity loss figures match those in the main report, but the authors should make sure they do.

- P.15. 'the loss of production caused by the hatchery closure would be expected to continue in perpetuity'. This could be perceived by some readers as an exaggeration. With proper justification, suspect state or federal government agencies could find ways to extend the hatchery supplementation program, even if funding is no longer provided by PacifiCorp.

Conclusions and Recommendations:

Considerable efforts were made to compile information from multiple sources on the past and current conditions of this system. A considerable amount of background information and pertinent data sets were used with information on the expected conditions of the habitat after dam removal. The results of the various forecasts made are not entirely encouraging in that moderate-severe impacts could be obtained under certain conditions, during and after short term dam removals. There appears to be a genuine need to make sure that certain assumptions, data and methods used for prediction purposes will still hold by the time dam demolition begins and that adjustments (if any) are done before 2019. Miscellaneous suggestions are given in the General comments section on possible ways of improving the main report and assessments results presented. What follows are general opinions that stem from this review for each of the 6 issues listed in the Terms of Reference (ToR).

ToR 1: Are the assumptions and the effects conclusions in the biological opinion scientifically reasonable/supportable and logical, especially pertaining to the suspended sediment analysis?

Some key papers cited in section 3.2 are not in the main report reference section (like Huang and Greiman 2010, Reclamation 2011c, Newcombe and MacDonald 1991, Walters et al. 2001), which makes it hard to figure out if the sediment model covers the effects of the major determinants of sediment loads and transport. And as noted in the general comments section, the definitions used for extreme and normal conditions need further clarification and justification. This would also help readers interpret Figures 15-16 (in log scale) in Section 5.1.2.2 focusing on suspended sediments, which also has many reports cited not in the Reference section.

Above issues aside, the laboratory investigation results used may not be representative of population level impacts under natural conditions, so caution is needed when making inferences based on these. As noted under general comments, the Newcome and Jensen (1996) model applies to salmon, with no certainty that sturgeon are affected by sediment loads similarly because of different biological attributes, physiological requirements, and habitat preferences. Juvenile and adult sturgeon can likely tolerate heavier loads of SSC for longer periods than salmon simply because they spend considerable time spent in/near streambeds where sediments accumulate. In the absence of lab studies and ancillary observations from tracking studies, one should consider conducting additional lab studies before 2019 to re-assess criteria used for green sturgeon (and eulachon as well). Despite the apparent shortcomings, the conclusions are nevertheless based on available study results published in scientific journals, and on [presumably] scientifically credible modelling procedures. As for other sections focusing

on sediment effects on other species (like section 6.3 for coho), despite the missing references, they rely on scientifically credible arguments and reports to account for impacts and risks to the various life history stages.

On this basis and at this time, the effect analysis is considered to be reasonable, supportable and logical, but efforts should be made to verify a few tenuous hypotheses, and re-assess potential impacts based on additional information obtained before 2019.

ToR 2: Is the herbicide effects analysis in the draft biological opinion scientifically reasonable/supportable and logical?

In general, the comments in section 6.1 appear to be scientifically sound, and based on information published in scientific journals. The predicted effects also account for the implementation of additional precautionary measures that should result in lower concentrations of Glyphosate (sold as *Roundup* earlier by Mosanto Co.) than those possibly causing sub-lethal effects on salmon. On this basis, the effect analysis is considered to be reasonable, supportable and logical. However, not having access to the NMFS (2009) report or more details on the eventual dosages used under specific conditions, I offer some comments for the authors to consider.

In southern British Columbia (B.C), Glyphosate is also used to control undesirable species in close proximity to aquatic ecosystems. According to SEC (2011), the average dosage used in some areas adjacent to coho spawning areas during 2007-2010 was 2.3 kg/ha, and was considered adequate when used in conjunction with other weed eradication measures. The maximum application rate stated in the main report (NMFS-FWS 2011, p.134) is 8 lbs per acre which translates to 9 kg per hectare, or >3 times the dosages used in southern B.C. The main report does not specify what the term 'active ingredient' amounts to, if it includes the surfactant as well and of what type, when the maximum dosage would be applied, and details on precautionary measures used. Without additional information, the 'maximum dosage' applications may not be required and/or desirable, at least by standards in B.C., which generally gets more rainfall than Oregon (more comparable to 50" rainfall in Table 24). Similar weed species control may not be required; use of the maximum dosage should be re-assessed.

Some surfactants are toxic to aquatic species, especially to amphibians. Silicone-based surfactants like *Sylgard 309* help improve the effectiveness of herbicides (Relyea 2005), and have been shown to be less acutely toxic than POEA-based surfactants often used with glyphosate (Monheit *et al.* 2004). Surfactants to be used in the Klamath River are not specified, except these should be 'no more toxic than POEA surfactants' (Table 12, p.41).

As noted above, herbicides are often used in conjunction with other weed control measures. On p.134, there is mention of 'minimization measures for herbicide treatment', but none are specified. Further down, 'although not stated in the report…. aerial application likely occurred'. This sentence is speculation and should be removed. Herbicide application should [ideally] not be conducted during windy periods or by aerial application when in close proximity to sensitive areas. Well known potential alternatives to herbicide use include hand-pulling, manual trimming,

steam and burn treatments, stripping and re-vegetation, use of natural herbicides or biocides. Many are time consuming, less cost-effective and less efficicient than herbicide applications in some contexts. Some trials using natural herbicide technology showed that soap-based (fatty acid) organic herbicides (ECF2 from EcoCare Technologies) was as effective to glyphosate against all weeds and grass over 3 months (see SEC 2011). At a minimum, the main report should include more details on the 'minimization measures to be used' (other than no spraying within 50' of a water body), and if alternatives to Glyphosate will be used near sensitive areas.

ToR 3: Are the critical habitat and coho salmon effects analysis comprehensive?

After two readings, no major gaps were detected. Considerable efforts were made to use scientifically credible methods, survey results, analytical methods, peer reviewed procedures and pertinent facts to account for plausible impacts. But before releasing the final report, additional efforts should be made to fill the reference gaps, and address the few issues concerning coho salmon highlighted in the general comments section.

ToR 4: Are there any missing critical assumptions and effects to fish and habitat (coho, eulachon and green sturgeon) that should be in the draft biological opinion?

There does not appear to be obvious gaps with regards to critical assumptions (except missing references). The authors of the main report seemingly made considerable efforts to use well designed survey results, commonly used analytical methods, peer reviewed procedures and pertinent facts to account for effects on fish and supporting habitats. Most assumptions appear to be reasonable and scientifically credible. Still, before the final report is released, additional efforts should be made to fill the reference gaps and address pertinent issues highlighted in the general comments section. There is an apparent paucity of information on the potential effects of sediment loads on egg/fry mortality and the spawning success of eulachon and green sturgeon, which could possibly be subject to further investigation before 2019. Sturgeon from the Columbia River and the Fraser River are currently subject to hatchery rearing and captive broodstock programs for conservation purposes, so program managers may consider such options to speed up the recovery process if impacts are judged to be potentially severe.

ToR 5: What sections of the draft biological opinion need to be improved, and any recommendations on how?

Missing references should be included, at a minimum for purposes of completeness. Information on what can/will be done to rectify information gaps and update model forecasts before 2019 would also help re-assure readers that some adjustments are still considered and will be assessed as additional survey data becomes available before dam demolition begins. The main report released should also list alternative mitigation/restoration measures still being contemplated.

ToR 6: Does the biological opinion represent the best scientific information available?

As concluded in a prior review of some planned Klamath River operations associated with the dam removal plan, a large number of in-depth investigations were done to gather much

background information to forecast impacts with methods commonly used in science and engineering. On this basis, I cannot confirm that the science reviewed is “the best scientific information available”, but it appears to be to a large extent based on “some of the best scientific information available”. That qualifier stems from the fact that there is always room for improvement, but one has to bear in mind that there is rarely (if ever) unlimited resources to address every conceivable issue and all unavoidable uncertainties about the future.

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Winship, A.J., and A.W. Trites. 2003. Prey consumption and Steller sea lions (*Eumetopias jubatus*) off Alaska: How much prey do they require? Fish. Bull. 101: 147-167.

Appendix 1

Copies of main scientific reports provided by the CIE for this review

Anon (2011): Killer whales and Steller sea Lions effects. Separate document for Sections 1.3.7 and 1.3.8 of NMFS-FWS 2011. 23 pp.

NMFS-FWS 2011. Joint Biological and Conference Opinion on the Proposed Removal of Four Dams on the Klamath River. CIE Review Draft Report by the National Marine Service (SW region) and the Fish & Wildlife Service (Region 8). NMFS File Number 151422SWR2011AR00104. Dec 16, 2011. 212 pp.

Additional Reference Documents provided for CIE reviewers Re Klamath Dam Removal Draft BO and EFH Assessment

Bartholomew JL and J.S. Foott. 2010. Compilation of Information Relating to Myxozoan Disease Effects to Inform the Klamath Basin Restoration Agreement.

DOI and CDFG (U.S. Department of the Interior and California Department of Fish and Game). 2011. Klamath facilities removal environmental impact statement/environmental impact report. Siskiyou County, California and Klamath County, Oregon. Cooperating Agency Draft. State Clearinghouse # 2010062060. U.S. Department of the Interior, through the U.S. Bureau of Reclamation (Reclamation), and California Department of Fish and Game (CDFG), Sacramento, California.

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Dunne T, Ruggerone G, Goodman D, Rose K, Kimmerer W, Ebersole J. 2011. Scientific assessment of two dam removal alternatives on coho salmon and steelhead. Klamath River Expert Panel final report. Prepared with assistance of Atkins.

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threatened coho salmon in the Southern Oregon / Northern California Coasts Evolutionarily Significant Unit. NOAA Technical Memorandum NMFS-SWFSC-432.

Appendix 2

Statement of Work Dr. Marc Labelle
External Independent Peer Review by the Center for Independent Experts

Biological Opinion on the Klamath Hydroelectric Settlement Agreement and accompanying EIS

Scope of Work and CIE Process: The National Marine Fisheries Service's (NMFS) Office of Science and Technology coordinates and manages a contract providing external expertise through the Center for Independent Experts (CIE) to conduct independent peer reviews of NMFS scientific projects. The Statement of Work (SoW) described herein was established by the NMFS Project Contact and Contracting Officer's Technical Representative (COTR), and reviewed by CIE for compliance with their policy for providing independent expertise that can provide impartial and independent peer review without conflicts of interest. CIE reviewers are selected by the CIE Steering Committee and CIE Coordination Team to conduct the independent peer review of NMFS science in compliance the predetermined Terms of Reference (ToRs) of the peer review. Each CIE reviewer is contracted to deliver an independent peer review report to be approved by the CIE Steering Committee and the report is to be formatted with content requirements as specified in Annex 1. This SoW describes the work tasks and deliverables of the CIE reviewer for conducting an independent peer review of the following NMFS project. Further information on the CIE process can be obtained from www.ciereviews.org.

Project Description: Pursuant to the National Environmental Policy Act (NEPA), the Department of the Interior (Department), through the Bureau of Reclamation (Reclamation), intend to prepare an EIS/EIR. The EIS consider whether to remove four dams on the mainstem Klamath River pursuant to the terms of the Klamath Hydroelectric Settlement Agreement (KHSA), thereby proposing the largest dam removal restoration action in US history. Conflicts over water and other natural resources in the Klamath Basin between conservationists, tribes, farmers, fishermen, and State and Federal agencies have existed for decades. Since 2003, the United States has spent over $500 million in the Klamath Basin for irrigation, fisheries, National Wildlife Refuges, and other resource enhancements and management actions. Consequently, the United States, the States of California and Oregon, the Klamath, Karuk, and Yurok Tribes, Klamath Project Water Users, and other Klamath River Basin stakeholders negotiated the Klamath Basin Restoration Agreement (KBRA) and the KHSA (including the Secretarial Determination) to resolve long-standing disputes between them regarding a broad range of natural resource issues. This is a landmark federal action with a recent litigious history. The project has large potential implications on the economy of California and Oregon, commercial, tribal and recreational fisheries in California and Oregon, and tribal and public trust resources.
The Terms of Reference (ToRs) of the peer review are attached in Annex 2.

Requirements for CIE Reviewers: Three CIE reviewers shall conduct an impartial and independent peer review in accordance with the SoW and ToRs herein. CIE reviewers shall have the combined working knowledge and recent experience in the application of hydrology, river restoration, and pacific salmon life history needs. Each CIE reviewer's duties shall not exceed a maximum of 10 days to complete all work tasks of the peer review described herein.

Location of Peer Review: Each CIE reviewer shall conduct an independent peer review as a desk review, therefore no travel is required.

Statement of Tasks: Each CIE reviewers shall complete the following tasks in accordance with the SoW and Schedule of Milestones and Deliverables herein.

Prior to the Peer Review: Upon completion of the CIE reviewer selection by the CIE Steering Committee, the CIE shall provide the CIE reviewer information (full name, title, affiliation, country, address, email) to the COTR, who forwards this information to the NMFS Project Contact no later the date specified in the Schedule of Milestones and Deliverables. The CIE is responsible for providing the SoW and ToRs to the CIE reviewers. The NMFS Project Contact is responsible for providing the CIE reviewers with the background documents, reports, and other pertinent information. Any changes to the SoW or ToRs must be made through the COTR prior to the commencement of the peer review.

Pre-review Background Documents: Two weeks before the peer review, the NMFS Project Contact will send (by electronic mail or make available at an FTP site) to the CIE reviewers the necessary background information and reports for the peer review. In the case where the documents need to be mailed, the NMFS Project Contact will consult with the CIE Lead Coordinator on where to send documents. CIE reviewers are responsible only for the pre-review documents that are delivered to the reviewer in accordance to the SoW scheduled deadlines specified herein. The CIE reviewers shall read all documents in preparation for the peer review.

Desk Review: Each CIE reviewer shall conduct the independent peer review in accordance with the SoW and ToRs, and shall not serve in any other role unless specified herein. Modifications to the SoW and ToRs can not be made during the peer review, and any SoW or ToRs modifications prior to the peer review shall be approved by the COTR and CIE Lead Coordinator. The CIE Lead Coordinator can contact the Project Contact to confirm any peer review arrangements.

Contract Deliverables - Independent CIE Peer Review Reports: Each CIE reviewer shall complete an independent peer review report in accordance with the SoW. Each CIE reviewer shall complete the independent peer review according to required format and content as described in Annex 1. Each CIE reviewer shall complete the independent peer review addressing each ToR as described in Annex 2.

Specific Tasks for CIE Reviewers: The following chronological list of tasks shall be completed by each CIE reviewer in a timely manner as specified in the Schedule of Milestones and Deliverables.

1) Conduct necessary pre-review preparations, including the review of background material and reports provided by the NMFS Project Contact in advance of the peer review.
2) Conduct an independent peer review in accordance with the ToRs (Annex 2).
3) No later than 16 January 2011, each CIE reviewer shall submit an independent peer review report addressed to the "Center for Independent Experts," and sent to Mr. Manoj Shivlani, CIE Lead Coordinator, via email to shivlanim@bellsouth.net, and CIE Regional Coordinator, David Die, via email to ddie@rsmas.miami.edu. Each CIE report shall be written using the format and content requirements specified in Annex 1, and address each ToR in Annex 2.

Schedule of Milestones and Deliverables: CIE shall complete the tasks and deliverables described in this SoW in accordance with the following schedule.

2 December 2011	CIE sends reviewer contact information to the COTR, who then sends this to the NMFS Project Contact
16 December 2011	The report availability date in which the NMFS Project Contact sends the CIE Reviewers the report and background documents
16 December 2011 – 16 January 2012	Each reviewer conducts an independent peer review as a desk review
16 January 2012	CIE reviewers submit draft CIE independent peer review reports to the CIE Lead Coordinator and CIE Regional Coordinator
30 January 2012	CIE submits the CIE independent peer review reports to the COTR
6 February 2012	The COTR distributes the final CIE reports to the NMFS Project Contact and regional Center Director

Modifications to the Statement of Work: Requests to modify this SoW must be approved by the Contracting Officer at least 15 working days prior to making any permanent substitutions. The Contracting Officer will notify the COTR within 10 working days after receipt of all required information of the decision on substitutions. The COTR can approve changes to the milestone dates, list of pre-review documents, and ToRs within the SoW as long as the role and ability of the CIE reviewers to complete the deliverable in accordance with the SoW is not adversely impacted. The SoW and ToRs shall not be changed once the peer review has begun.

Acceptance of Deliverables: Upon review and acceptance of the CIE independent peer review reports by the CIE Lead Coordinator, Regional Coordinator, and Steering Committee, these reports shall be sent to the COTR for final approval as contract deliverables based on compliance with the SoW and ToRs. As specified in the Schedule of Milestones and Deliverables, the CIE shall send via e-mail the contract deliverables (CIE independent peer review reports) to the COTR (William Michaels, via William.Michaels@noaa.gov).

Applicable Performance Standards: The contract is successfully completed when the COTR provides final approval of the contract deliverables. The acceptance of the contract deliverables shall be based on three performance standards:
(1) each CIE report shall completed with the format and content in accordance with Annex 1,
(2) each CIE report shall address each ToR as specified in Annex 2,
(3) the CIE reports shall be delivered in a timely manner as specified in the schedule of milestones and deliverables.

Distribution of Approved Deliverables: Upon acceptance by the COTR, the CIE Lead Coordinator shall send via e-mail the final CIE reports in *.PDF format to the COTR. The COTR will distribute the CIE reports to the NMFS Project Contact and Center Director.

Support Personnel:

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Annex 1: Format and Contents of CIE Independent Peer Review Report

4. The CIE independent report shall be prefaced with an Executive Summary providing a concise summary of the findings and recommendations, and specify whether the science reviewed is the best scientific information available.

5. The main body of the reviewer report shall consist of a Background, Description of the Individual Reviewer's Role in the Review Activities, Summary of Findings for each ToR in which the weaknesses and strengths are described, and Conclusions and Recommendations in accordance with the ToRs.

6. The reviewer report shall include the following appendices:
   Appendix 1: Bibliography of materials provided for review
   Appendix 2: A copy of the CIE Statement of Work

Annex 2: Terms of Reference for the Peer Review

Biological Opinion on the Klamath Hydroelectric Settlement Agreement and accompanying EIS

1. Are the assumptions and the effects conclusions in the biological opinion scientifically reasonable/supportable and logical, especially pertaining to the suspended sediment analysis?
2. Is the herbicide effects analysis in the draft biological opinion scientifically reasonable/supportable and logical?
3. Are the critical habitat and coho salmon effects analysis comprehensive?
4. Are there any missing critical assumptions and effects to fish and habitat (coho, eulachon and green sturgeon) that should be in the draft biological opinion?
5. What sections of the draft biological opinion need to be improved, and any recommendations on how?
6. Does the biological opinion represent the best scientific information available?